Sept. 3, 1963 R. H. SEVERANCE ETAL 3,102,480

TIMING AND/OR DELAY DEVICE

Filed March 18, 1955

FIG. 1

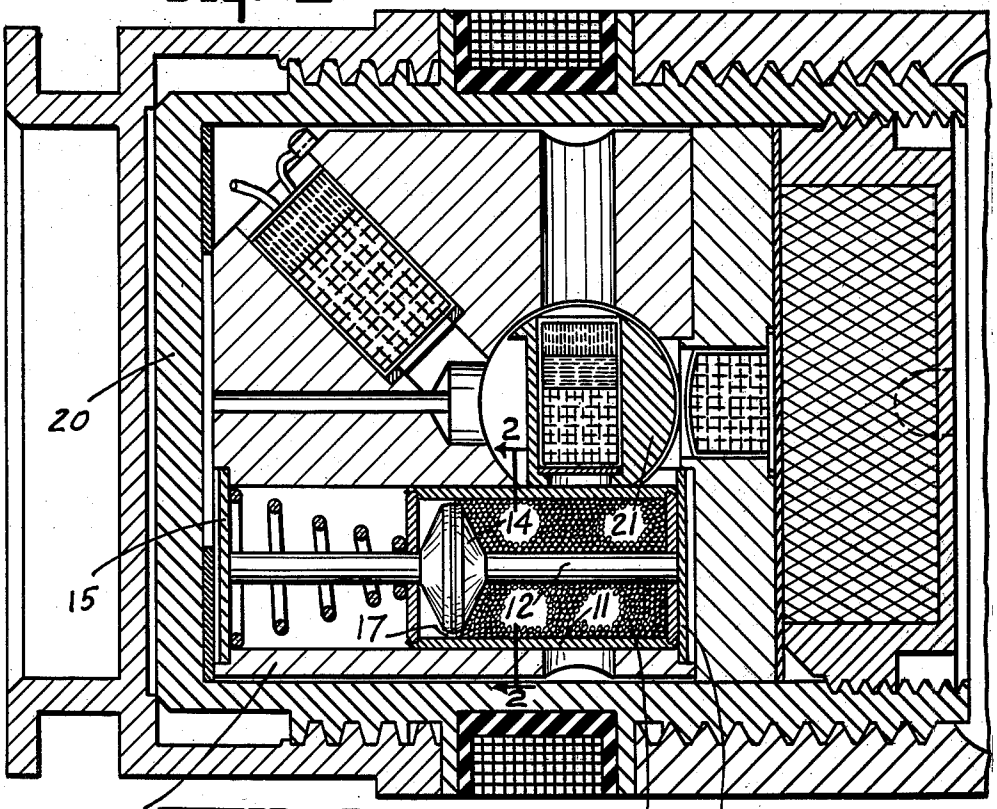


FIG. 3

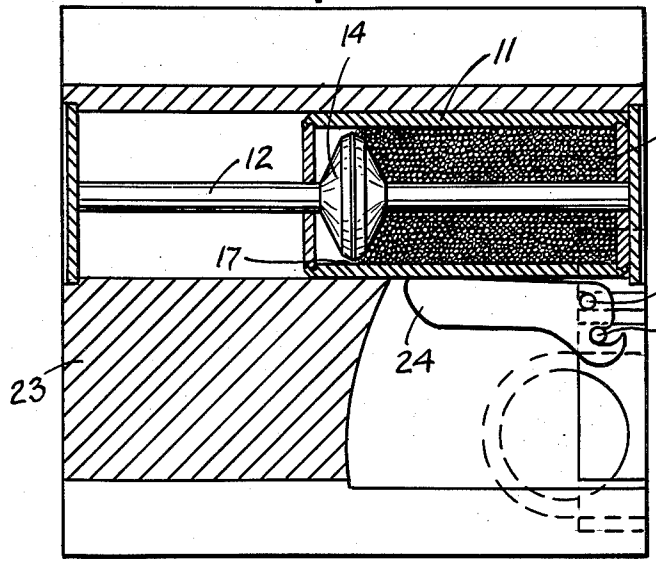
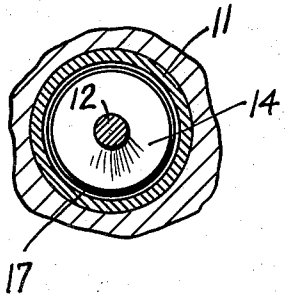


FIG. 2



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3,102,480

TIMING AND/OR DELAY DEVICE

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4 Claims. (Cl. 102—78)

This invention relates generally to timing and/or delay devices, and more particularly it relates to timing and/or delay devices especially adapted for arming projectiles and rockets.

Conventional timing and/or delay devices for projectile fuzes and rocket fuzes usually consist of a clock mechanism. Such mechanisms are relatively expensive to manufacture and of delicate structure such that rough handling during shipment, storage, and use often causes failure.

Accordingly, the principal object of this invention is to provide a timing and/or delay device for projectile fuzes and the like which has simple structure and which operates only in response to accelerative forces or decelerative forces of predetermined magnitude.

Another object of this invention is to provide a timing and/or delay mechanism for projectiles and the like which may be actuated in response to accelerative or decelerative forces of predetermined magnitude to arm or explode a projectile or a rocket after the projectile or rocket has travelled a predetermined distance along its trajectory.

In accordance with this invention there is provided a timing and/or delay device consisting of a cylinder, a plurality of relatively small beads within the cylinder, and a plunger or shaft having a node thereon mounted within said cylinder, said shaft or node having a predetermined clearance with respect to the wall of the cylinder for permitting flow of beads between said wall and the plunger or node, whereby the forces of acceleration or deceleration may cause relative movement between said cylinder and said plunger or node.

The full nature of the invention will be understood from the accompanying drawings and the following description and claims:

FIG. 1 is a longitudinal cross section illustrating the timing and/or delay device provided in accordance with this invention as it is incorporated in a rocket fuze, for example.

FIG. 2 is a partial cross-section taken on line 2—2 of FIG. 1.

FIG. 3 is a longitudinal cross-section of a trigger device operatively associated with this invention.

Referring to the drawings, there is provided in accordance with this invention a timing and/or delay device comprising a supporting member 10 within which may be mounted in slideable relation thereto a cylinder 11. Within the cylinder 11 there is slideably mounted with respect thereto a shaft 12 having a plunger or node portion 14, shaft 12 being held in fixed position by the walls 15 of the supporting member 10. Within the cylinder 11 there are stored a large number of small beads, preferably formed of glass and having a diameter on the order of .0055 in.–.0065 in. The node or plunger 14 is dimensioned to have an external diameter such that there is a clearance as at 17 between the outer edge of the plunger of the node and the cylinder wall only slightly in excess of the diameter of the beads. Thus, the beads may flow between the outer edge of the plunger and the cylinder wall, provided that accelerative force is applied to the beads and to the cylinder 11.

It it is desired to utilize this invention for timing or delaying the arming of a projectile or rocket, the shaft 12 may be mounted within the casing of the fuze 20 of

such projectile or rocket in fixed relation thereto. The cylinder 11 may be mounted for sliding movement on rod 12 with the plunger 14 located within cylinder 11 adjacent the rear end thereof with respect to the direction of motion of the projectile or rocket. When the projectile or rocket is launched, in this case to the right (FIG. 1), the accelerative forces acting on cylinder 11 cause it to move rearwardly on rod 12, thereby putting pressure on the beads contained within the cylinder. The same accelerative forces act on the beads causing them to flow between the outer edge of the plunger or node 14 and the wall of cylinder 11. This mechanism performs the mathematical solution of the following equation:

$$\int\int ADTDT = K$$

where

A=acceleration

T=time

K=a constant depending upon the design.

Accordingly, within a certain period of time, depending upon the rate of acceleration of the projectile or rocket, the cylinder 11 will move along rod 12 until plunger 14 engages the forward end of the cylinder. Cylinder 11 may then be utilized to release a detonator 21 for rotational movement in response to accelerative forces. This has the effect of arming the projectile or rocket. Further description is not deemed to be necessary as the fuze in itself does not constitute any part of this particular invention. This invention forms the subject matter of application for United States Letters Patent, Serial No. 495,279, filed March 18, 1955, for Fuze Mechanism.

Another application of the timing and/or delay mechanism provided in accordance with this invention comprises the cylinder 11 and its associated elements mounted in a fuze 23 for controlling a firing mechanism, part of which includes a trigger 24 pivotally mounted on a pin 25 and held in engagement with cylinder 11 by a firing pin 26. Assuming the direction of flight to be to the left (FIG. 3) deceleration of the projectile or rocket will cause timed movement of cylinder 11 to the left out of the way of trigger 24, permitting clockwise rotation thereof and release of firing pin 26. This action will be timed or delayed, as explained heretofore, by the resistance of the beads 16 flowing between the outer edge of node 14 and the walls of cylinder 11.

While this invention has been disclosed and illustrated as a part of a projectile or rocket, it will be understood that it is equally applicable for timing the heating cycle of electric toasters or stoves. A spring mechanism may be arranged in connection with the cylinder 11, whereby the force stored in a spring may be released to actuate the cylinder 11 to create relative movement between the cylinder 11 and the rod 12. The flow of beads between the outer edge of the plunger or node 14 and the wall of the cylinder can occur only at a given rate depending upon the forces acting on the beads. Therefore, a certain time interval will be required for the relative movement of cylinder 11 from one end of rod 12 to the other. As described above in connection with a fuze, a suitable trigger member or actuating device can be released or actuated by the cylinder 11.

The invention claimed is:

1. A mechanism having an operation cycle of predetermined time duration comprising a support, a member movably mounted on said support, and a control device for releasing said member after a predetermined time period in response to an external accelerative force comprising a shaft fixed relative to said support, a container member disposed relative to said movable member to immobilize said movable member and slidably mounted on one end of said shaft for movement in response to said

accelerative force to release said movable member, a plunger fixed to said shaft and spaced from the ends thereof within one end of said container member to form a small chamber and a large chamber within said container member, said plunger having clearance space between it and the walls of said container, and glass beads filling said large chamber and having a diameter slightly smaller than the clearance between said plunger and said container member, whereby accelerative forces acting longitudinally of said shaft on said beads and said container member toward said small chamber cause the flow of said beads around the edges of said plunger into said small chamber and movement of said container member toward the small chamber at a rate proportional to said forces.

2. A mechanism having an operation cycle of predetermined time duration comprising a support, a member movably mounted on said support, and a control device for releasing said member after a predetermined time period in response to an external accelerative force comprising a shaft fixed relative to said support, a container member disposed relative to said movable member to inhibit actuation of said movable member and slidably mounted on said shaft for movement in response to said accelerative force to release said movable member, a node fixed to said shaft and spaced from the ends thereof within one end of said container member to form a small chamber and a large chamber within said container member, said node having clearance space between it and the walls of said container, and particles of solid material filling said large chamber and having a diameter slightly smaller than the clearance between said node and said container member, whereby accelerative forces acting longitudinally of said shaft on said particles and said container member toward said small chamber cause the flow of said particles around the edges of said node into said small chamber and movement of said container member toward the small chamber at a rate proportional to said forces.

3. A mechanism having an operation cycle of predetermined time duration comprising a support, a member movably mounted on said support, and a control device for releasing said member after a predetermined time period in response to an external accelerative force comprising a container member disposed relative to said movable member to inhibit actuation of said movable member and slidably mounted on said support for movement in response to said accelerative force to release said movable member, a stationary plunger within one end of said container member forming a small chamber and a large chamber within said container member, said plunger having clearance space between it and the walls of said container, and particles of solid material filling said large chamber and having a diameter slightly smaller than the clearance between said plunger and said container member, whereby longitudinal accelerative forces acting on said particles and said container member toward said small chamber cause the flow of said particles around the edges of said plunger into said small chamber and movement of said container member toward the small chamber at a rate proportional to said forces.

4. A fuze mechanism having an operation cycle of predetermined time duration comprising a support, a detonator member movably mounted on said support, and a control device for releasing said member after a predetermined time period in response to an external accelerative force comprising a container member disposed relative to said member to immobilize said member and slidably mounted on said support for movement in response to said accelerative force to release said member, a stationary plunger within one end of said container member forming a small chamber and a large chamber within said container member, said plunger having clearance space between it and the walls of said container, and particles of solid material filling said large chamber and having a diameter slightly smaller than the clearance between said plunger and said container member, whereby longitudinal accelerative forces acting on said particles and said container member toward said small chamber cause the flow of said particles around the edges of said plunger into said small chamber and movement of said container member toward the small chamber at a rate proportional to said forces.

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